UNITED STATES DEPARTMENT OF AGRICULTURE
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Bureau of Plant Industry
and
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AMERICAN-EGYPTIAN COTTON QUALITY AND GINNING

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INTRODUCTION

The commercial production of American-Egyptian cotton began in 1912 in the irrigated sections of the Southwest, after the segregation of a variety known as Yuma in 1908 2/. This variety was planted in the Salt River Valley in Arizona and the Imperial Valley in California. It averaged 1-7/16 inches in staple length. Pima cotton displaced the Yuma variety in 1913, being grown almost exclusively until 1934 in the Salt River Valley of Arizona. The staple averaged 1-9/16 inches in length. A small acreage of a new hybrid variety called SxP, developed from a cross of Pima and Sakellaridis, was planted in 1935; and now it makes up a substantial portion of the American-Egyptian crop. It is shorter in staple length than Pima.

1/ Credit is due to Francis L. Gerdes, Senior Cotton Technologist, Agricultural Marketing Service, and Charles A. Bennett, Senior Mechanical Engineer, Bureau of Agricultural Chemistry and Engineering, for supervision and suggestions, and to co-workers in both agencies for their assistance.

2/ Yearbook of Agriculture 1936.

The annual production of American-Egyptian cotton has fluctuated widely since 1918, as shown in table 1, the peak year being 1920 when 92,561 bales were produced as compared with a low production of only 4,319 bales 4 years later.

Table 1. - Production of American-Egyptian cotton, crops 1918-40 1/

Crop year	No. of running bales	Crop year	No. of running bales	Crop year	No. of running bales
1918	36,187	1926	16,232	1934	14,052
1919	40,437	1927	24,223	1935	17,619
1920	92,561	1928	23,313	1936	17,551
1921	37,094	1929	28,771	1937	10,991
1922	32,824	1930	23,312	1938	20,501
1923	22,426	1931	13,668	1939	26,826
1924	4,319	1932	8,365	1940	32,359
1925	20,053	1933	9,683		

1/ Compiled from reports of the Bureau of Census.

In recent years due to the increased acreage of SxP the annual production is again on the increase. The area planted to SxP in 1935 amounted to 1,700 acres, and in 1936, to about 9,000 acres. In 1937, SxP amounted to over one-third of the crop as compared with an estimated one-half in 1938, three-fourths in 1939, and about 90 percent in 1940 3/. Indications are that the SxP acreage in 1941 will probably exceed 125,000 acres. According to the August 8, 1941 report of the Crop Reporting Board of the U. S. Department of Agriculture, the acreage in cultivation July 1, 1941, less 10-year average abandonment, was 127,400 acres with an indicated yield of 80,000 bales on August 1, 1941. The gradual expansion in American-Egyptian cotton acreage is due to a continuous demand for this cotton at prices that make its production profitable, especially on land on which there are no restrictions for its production under the Agricultural Adjustment Administration program. Short cotton has been generally planted on the allotted acres and SxP on the acres outside the allotment.

The shift from Pima to SxP planting is associated not only with the greater net returns per acre due to better turnout and yield of the SxP cotton but to increased preference of many spinners for this cotton over Pima. SxP cotton seems to compare favorably in character with imported Egyptian varieties

3/ Kearney, T. H., Peebles, R. H., and Smith, Gordon E., SxP cotton in comparison with Pima, U. S. Dept. Agr. Cir. 550, 15 pp., illus., 1940.

and has been found satisfactory by thread yarn spinners 4/. In these respects, SxP seems to be superior to Pima, but the extra staple length of Pima cotton is preferred by certain manufacturers of finer yarns in spite of the fact that stronger and smoother yarns can be made from SxP than from Pima 5/.

Pima cotton, and to a lesser extent, SxP, are thought by many commercial spinners to have some inherent weaknesses from a character standpoint, and some complaints have been registered against the character of this cotton by manufacturers. However, some of the causes of complaint by merchants and manufacturers in regard to American-Egyptian cotton are such that it should be possible for growers and ginners to remove them. Poor preparation and careless packaging are among the objectionable procedures that should be corrected 6/. Much of the poor ginning in 1940 in Arizona is attributable to carelessness in harvesting, handling, and ginning, although some is traceable to the adverse effects of the water shortage in certain sections on the character of the fibers at harvesting time and the ultimate effect of that shortage on the preparation of the ginned lint. Care in harvesting and ginning American-Egyptian cotton will contribute materially to its successful competition with Egyptian cotton and other extra-long staple cottons. Therefore, the problem of harvesting, ginning, and packaging must be carefully considered.

Care in harvesting American-Egyptian cotton is also very important because this cotton is less responsive to mechanical cleaning than upland cotton. Its longer length of staple and distinguishing physical properties make it more likely to be machined and roped during some cleaning processes than upland cotton. Improved ginning and handling practices can do much to improve the quality of the lint and consequently increase the profits from growing this cotton.

Some helpful ginning information is available to growers and ginners of American-Egyptian cotton, but there is need of further information in the light of recent developments in harvesting and ginning. Experimental work is under way to provide additional data needed to solve the many ginning problems now being encountered. In spite of the limitations of existing information, a summary of available data bearing on these problems should be of assistance in providing better ginning; therefore, it is the purpose of this publication to summarize the information which has been obtained through experiments and surveys

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4/ Pressley, E. H., Whitaker, Rodney, and Barr, George W., American-Egyptian cotton utilization, supplies and prices, Ariz. Agr. Expt. Sta., Bull. No. 167, 77 pp., illus., 1940.

5/ Campbell, Malcolm E., Karrer, Enoch, and Cook, John W., Spinning and fiber properties of Pima, SxP, and a Pima-SxP backcross. U. S. Dept. Agr., Agr. Mktg. Serv., Bur. Plant Indus., in cooperation with Clemson Agr. Col., 1940, 13 pp., illus., 1940. (Processed).

6/ See footnote 4.

conducted in connection with the ginning of American-Egyptian cotton by the U. S. Department of Agriculture as well as those made by other agencies.

QUALITY OF AMERICAN-EGYPTIAN COTTON

American-Egyptian cotton has fibers that are much finer and more silklike than those of upland cotton. The color is a deeper yellow than rain-grown upland cotton, although recent crops of Pima cotton have been reported to be of lighter shade than those of earlier years. SxP is of a lighter yellow color than Pima. Samples of American-Egyptian cotton are rough and lumpy in appearance, attributable primarily to the roller ginning process rather than to any inherent quality of the cotton. The grade standards for classification of both Pima and SxP cottons are prepared in physical form in nine grades, No. 1, No. 1-1/2, No. 2, No. 2-1/2, No. 3, No. 3-1/2, No. 4, No. 4-1/2, and No. 5. Cotton falling under grade No. 5 is designated as below grade 7/. In this manuscript, the expression "grade step" is used to mean the spread from a full grade designation to an adjacent half-grade designation.

Statistics on the quality of American-Egyptian cotton have been available since 1928. There has been wide variation in the quantity of cotton produced of each grade during the period 1928-40; as shown by table 2. The general trend in quality, however, was upward until 1938, with a peak of 72 percent of the crop falling in the grades of 1 and 1-1/2. In 1939 and 1940, the proportion of cotton of these grades dropped to one-fifth of the crop as a result of unfavorable weather conditions, late harvestings, and other factors.

Table 2. - American-Egyptian cotton production of specified grades in the United States, by seasons, 1928-29 to 1939-40 1/

Crop year	Grade 1 and 1-1/2	Grade 2 and 2-1/2	Grade 3 and 3-1/2
	Percent	Percent	Percent
1928	19	48	33
1929	19	57	24
1930	27	49	24
1931	9	43	48
1932	24	45	31
1933	51	44	5
1934	44	40	16
1935	19	68	13
1936	20	52	28
1937	66	26	8
1938	72	25	3
1939	20	43	37
1940	19	44	37
Average	32	46	22

1/ Compiled from reports of the Bureau of Agricultural Economics (1928-37) and the Agricultural Marketing Service (1938-40). Figures for 1940 are preliminary.

7/ The classification of cotton, U. S. Dept. Agr. Misc. Pub. 310, 54 pp., illus., 1938. Prepared by the Bureau of Agricultural Economics.

The staple length of American-Egyptian cotton ranges from about 1-7/16 inches to 1-5/8 inches and longer. The proportion of the crop in the specified staple length ranges is given in table 3.

Table 3. - American-Egyptian cotton production of specified staple lengths in United States, by seasons, 1928-29 to 1939-40 1/

Crop year	Shorter than 1-9/16 inches	1-9/16 and 1-19/32 inches	1-5/8 inches and longer
	Percent	Percent	Percent
1928	50	44	6
1929	19	59	22
1930	11	69	20
1931	18	61	21
1932	56	31	13
1933	34	56	10
1934	33	52	15
1935	28	68	4
1936	26	61	13
1937	27	59	14
1938	26	49	25
1939	5	32	63
1940	83	17	0
Average	28	57	15

1/ Compiled from reports of the Bureau of Agricultural Economics (1928-37) and the Agricultural Marketing Service (1938-40). Figures for 1940 are preliminary.

The proportion of the crop in each staple length varies considerably from year to year. In 1939 the staple length of the crop was longer than that of the previous 11-year average. The average staple length of the 1940 crop was less than that of the 1939 crop, although it was almost 1-1/2 inches. Adverse weather conditions during the fall, and the water shortage during the summer months in some sections, are responsible in part for this reduction in staple length, but the increased proportion of the crop represented by SxP is also a contributing factor.

Preliminary data obtained in connection with the classification of 6,500 samples, representing the total ginnings of six ginning plants in Arizona in 1940, indicated that, of these ginnings, more than 50 percent were reduced 1/2 grade, and 7 percent, 1 grade or more, because of rough ginning preparation. Some of this poor preparation was considered to be associated with abnormal immaturity of the fibers caused by water shortage during the boll development and ripening period in some sections of the Salt River Valley. A large part of the poor preparation, however, was caused by the ginning of cotton of high moisture, this moisture being the result of periodic rains during the harvesting season over the entire area of SxP production. Much of the cotton was carelessly harvested in a damp or wet condition and ginned without prior conditioning.

The average grade reduction attributable to rough preparation of these ginnings was about one-third grade.

HARVESTING AND HANDLING

The condition of the cotton as it comes to the gin is an important factor in determining the quality of the ginned lint with upland cotton, and is still more important with long staple American-Egyptian and sea-island cotton types. Cotton harvested early in the season is often ginned in a green and damp condition; and, as a consequence, it is ginned rough unless it is dried in the field or at the gin. Occasional rains and showers are factors responsible for the harvesting of damp cotton. In addition to causing rough ginning, excess moisture in seed cotton, tests have shown, prevents adequate cleaning of the seed during roller ginning, and increases manufacturing waste about 10 pounds per bale.

Undue exposure of seed cotton to weather, between opening of the bolls and time of picking, is an additional cause of damage to the quality of American-Egyptian cotton. The fibers, as well as the seed, are adversely affected in this manner. Rains, especially when accompanied by winds, cause dust and dirt to be washed into the cotton and thus reduce its brightness, as shown in figure 1. Even if little or no rain occurs, cotton that is creamy when it first opens will bleach out and become less creamy the longer it is exposed in the field 8/.

Seed cotton left in the field becomes more trashy as the season progresses. Early in the season when the foliage is green, the only source of leaf trash is the bracts of bolls. Later on, the foliage gradually dries out, so that it is increasingly difficult to pick the cotton without including some leaf particles. Bolls that open late are often damaged or immature, making it laborious to harvest the seed cotton without some of the burs breaking and adhering to it. American-Egyptian cotton should be harvested as dry and as cleanly as possible because mechanical driers and cleaners are not effective enough to put damp and trashy cotton of this type in such condition that it will gin out a sample of a grade comparable to that ginned from carefully harvested cotton ginned without processing through such units. Driers and cleaners go a long way, however, toward restoring the qualities the cotton had before it was carelessly harvested.

COMMERCIAL GINNING EQUIPMENT AND OPERATING PRACTICES 9/

As a result of increased plantings of American-Egyptian cotton of the SxP variety, six new roller gin plants, equipped with a total of one hundred 40-inch roller gin stands, were installed in 1940 in the western irrigated section of the Cotton Belt. One of these outfits was installed in the El Paso Valley of Texas, one in the Gila Valley, and four in the Salt River Valley of Arizona (fig. 2).

8/ Nickerson, Dorothy. Grade of cotton affected by exposure in the field, U. S. Dept. Agr., Bur. Agr. Econ., 12 pp., illus., 1933. (Processed)

9/ Townsend, J. S., Ginning Pima cotton in Arizona. U. S. Dept. Agr. Dept. Bull. No. 1319, 11 pp., illus., 1925.

The gin stands in three of these new plants were newly constructed but in the others they were rebuilt and brought up to good mechanical condition. These new plants, together with existing plants, make a total of 24 roller ginning establishments, comprising a total of 328 gin stands in operation in 1940, in the irrigated sections of the Cotton Belt (fig. 3). These roller gin plants ginned an average of about 100 bales per stand. The majority of the plants had double battery systems utilizing a one-bale press.

A general practice among ginners of American-Egyptian cotton is to place the farmer's cotton in storage where it awaits its turn to be ginned. In 1940, almost 90 percent of the ginning establishments had storage facilities for their customers. Cotton is conveyed pneumatically, either to the cotton house or to the gin, and separated from the conveying air by use of a dropper. During recent years, however, some ginners expressed an interest in the adoption of a Rembert-type fan and blow-box system for use in unloading cotton and depositing it in the gin house or storage building.

In 1940, 29 percent of the buildings housing the roller gins in the West were of all-steel or concrete fireproof construction, whereas, in the remainder of these gins, steel covering with wood framing and concrete floors were used. A few of the older gins are of one-story construction with pneumatic droppers over each stand, and the cleaning and extracting equipment is located in one end of the building. All the new installations and most of the older ones are of two-story construction. In these plants the cleaning equipment is on the second floor, and the cotton is passed to the stands by gravity chutes to the feeder.

For cleaning the cotton, every roller gin in the West was equipped with extractors of the type used as unit extractor cleaner-feeders in saw gins, over 60 percent of them being used in combination with a multi-cylinder cleaner. Three-fourths of the extractors were the larger-sized units, while the remainder were the standard one-section type. The gins were equipped with cleaning feeders of the spiked drum type. Generally, one extracting unit will handle all the cotton ginned by 6 to 8 stands. Only three of the gin plants were equipped with drying equipment for conditioning the cotton. According to ginners' estimates in 1940, about one-third of the crop was harvested in a damp condition and needed drying, and over three-fourths was trashy at the time of ginning.

The pressing equipment in almost 90 percent of the roller gins was constructed of wood and that of the remainder, of steel. Only one of the 24 gins used a double box press, the others being equipped with single box undershot presses set in a pit with the press box on the ground floor level.

Eighty-seven percent of the gins were operated by electric motors, the other 13 percent by Diesel engines. The power requirements per gin stand averaged 7-1/2 horsepower for the 40-inch gins and about 12 horsepower for the 72-inch gins.

TESTS OF CLEANING AND CONDITIONING UNITS

American-Egyptian cotton differs from sea-island cotton in that it can be fairly well cleaned mechanically with extractor cleaner-feeders, as shown in

table 4 10/. By adding a three-cylinder cleaner and an extractor unit to a big drum cleaner in a series of laboratory tests on a 4-stand, 40-inch gin set-up, the grade of the cotton was enhanced an average of 1.4 grade steps. This grade improvement, because of the removal of foreign matter from the seed cotton prior to ginning, adds several dollars to the bale value of the cleaned cotton. The cleaning set-up, involving the big drum cleaner-feeder, the extractor, and the 3-cylinder cleaner, removed almost three times as much foreign material as the big drum cleaner-feeder alone; and this removal of foreign matter caused the gin stands to function more effectively in removing the lint from the seed. The additional lint removed, almost offset the bale-weight loss that would have resulted from trash removal.

Table 4. - Average of certain quality elements of the lint and other factors associated with cleaning

Cleaning set-up	Grade	Staple	Bale weight 1/	Foreign matter removed 1/	Ginning time per stand 1/	Lint ginned per stand per hour
	Steps	1/32"	Pounds	Pounds	Minutes	Pounds
Big drum cleaner	5.0	50.9	432	15	576	42.7
Big drum cleaner, extractor unit, and 3 cleaning cylinders	3.6	51.2	426	40	544	44.6

1/ For 1,500 pounds of seed cotton.

Grade improvements, ranging from one to four grade steps, were associated with cleaning at commercial gins in operation during the last season. The test of commercial gins further showed that better cleaning was obtained with the larger-sized cleaner-extractor units than with the standard one-section units, and that scarcely any additional grade benefits were derived by adding cylinder cleaners to extracting units.

EXPERIMENTS WITH GIN-STANDS

Factors found to be important with roller gins so far as ginning quality and efficiency are concerned include seed cotton characteristics as well as machinery used and methods of gin operation. SxP cottonseed are less fuzzy than Pima seed, are shed more readily by the seed grid of the gin, and, therefore, SxP cotton can be more rapidly ginned than Pima. Some of the difference in ginning rate is due to the higher lint percentage of the SxP cotton 11/. It has been found that this cotton gins at least 20 to 25 percent faster than Pima.

10/ Martin, William J., Townsend, James S., and Walton, Thomas C., Sea-island cotton quality and ginning, U. S. Dept. Agr., Agr. Mktg. Serv., Bur. Plant Indus., and Agr. Chem. and Engin., 15 pp., illus., 1940. (Processed)

11/ See footnote 5, page 3.

Crank Speeds

In a series of tests conducted at Sacaton, Ariz., by staff members of the U. S. Cotton Ginning Laboratory (Stoneville, Miss.), on a 4-stand 40-inch roller gin, the speed of the crank or moving knife was varied from 650 to 840 revolutions per minute. The results of these tests are shown in table 5. The

Table 5. - Averages of certain quality elements of the lint and other factors associated with crank speeds

Crank speed	Grade	Staple length	Bale weight 1/	Ginning time per stand 1/	Lint ginned per stand per hour
R.P.M.	Steps	1/32 inch	Pounds	Minutes	Pounds
650	4.2	51.0	430	612	40.0
840	4.0	51.0	428	504	48.3

1/ For 1,500 pounds of seed cotton.

speed of the crank had very little effect on the bale weight or turn-out, as shown in the table. The ginning time was considerably lessened, however, by increasing the speed of the crank and the moving knife. By increasing the speed of the crank from 650 revolutions to 840 revolutions per minute, or 29 percent, the amount of lint ginned per stand per hour increased from 40.0 to 48.3 pounds, or 21 percent. The staple length of the cotton was not changed by increasing the crank speed but to a small extent the grade appeared to be favorably affected. These tests and subsequent field observations indicated that with well-built and well-braced gins, equipped with counter-balanced crank shafts, the speed of western gins could be increased to 900 revolutions per minute or more.

The survey at the commercial roller gins in operation in 1940 showed that none of the gins were operating at unusually high speed, nor were any equipped with fully counter-balanced crank shafts, nor designed so that the speed of the knife could be stepped up to provide continuous ginning and improved capacity. The operating crank or eccentric speeds of the roller gins ranged from 650 to 780, and averaged 720 revolutions per minute. Twenty-five percent of the gins used eccentrics and 75 percent used cranks for driving the moving knife. More than three-fourths of the cranks were of wood construction and one-fourth of steel. Bronze bearings were used in 59 percent of the gins; babbitt bearings, in 23 percent; and ball bearings, in only 18 percent.

Roller Coverings and Speeds

Since walrus hide for roll covering is now prohibitive in price and difficult to obtain, operators of roller gins are turning to a composition of rubber and cotton fabric packing as a substitute. Surveys made at gins in

operation in 1940 showed that almost 60 percent of them had their rollers covered with one-half walrus and one-half packing, while one-fourth used all packing. One gin used one-third packing and two-thirds walrus, whereas another used two-thirds packing and one-third walrus for roll covering. The life of the roller covering used in the 40-inch single roller-type gins averaged 140 bales for those using one-half packing and one-half walrus, and 275 bales for those using all packing. The larger, or 72-inch stands, utilized half packing and half walrus for roller coverings, and were able to gin about 260 bales before re-covering was necessary. The additional ginnings obtained on these larger gins before re-covering were due to the increased ginning surface provided by the greater length and larger diameter of the rollers. Only one-half of the Arizona roller gins had their rollers in good condition, and very few had them properly grooved for efficient ginning.

Packing of various kinds, as well as methods of attaching the packing to the core of the rollers, has been tried at the U. S. Cotton Ginning Laboratory 12/, 13/. These tests showed definitely that composition-covered rollers could be, and are, successfully used. These rollers may be made up either of all composition packing or with the composition in combination with walrus hide.

A new roller, recently developed and tried with very promising results, is the "semi-self grooving type," shown in figure 4. It is constructed with a strip of 3/16- to 1/4-inch leather belt between every two strips of packing. Since the leather is softer than the packing, it will wear faster and stay just below the surface, serving as a groove to clear the knife of any foreign matter which may be in the cotton. At the present time (1941), the cost of the material for this roller is not much more than that for the all-packing roller, and is substantially less than that for the combination packing and walrus roller now extensively used (table 6).

The results of a series of tests conducted at Sacaton, Ariz., by staff members of the U. S. Cotton Ginning Laboratory, in a 4-stand, 40-inch roller gin in which the walrus roller speed was varied from 110 to 150 revolutions per minute, are shown in table 7. The bale weight or turnout was not affected by the speed of the roller. However, by increasing the speed of the roller from 110 to 150 revolutions per minute, or 36 percent, the amount of lint ginned per stand per hour was stepped up from 41.5 to 49.2 pounds, or 19 percent. The staple length of the cotton was not affected by increasing the roller speed, and the indicated difference in grade steps was insignificant.

12/ Townsend, James S., Walton, Thomas C., and Martin, William J., Roller-gin construction, maintenance, and repair. U. S. Dept. Agr., Bur. Plant Indus., Bur. of Agr. Chem. and Engin., and Agr. Mktg. Serv., 14 pp., illus., 1940. (Processed)

13/ Developments in roller covering for roller cotton gins, U. S. Dept. Agr., Bur. Agr. Chem. and Engin., Agr. Mktg. Serv., and Bur. of Plant Indus., A.C.E. 85, 6 pp., March 1941. (Processed)

Table 6. - Approximate cost of material for covering a 40-inch gin roller on a stock 5 inches in diameter 1/

Type of roller covering	Material	Amount needed	Unit cost	Cost	Total cost
			Dol.	Dol.	Dol.
All packing	Packing 5/8" x 5/8"	18.0 lbs.	0.75	13.50	13.50
Packing and belting (semi-self-grooving)	Packing 5/8" x 5/8"	16.5 lbs.	.75	12.38	--
	Leather belting 3/16" to 1/4"	44 ft.	.06	2.64	15.02
	Packing 3/4" x 3/4"	19.6 lbs.	.75	14.70	--
	Leather belting 3/16" to 1/4"	43 ft.	.06	2.58	17.28
1/2 Walrus and 1/2 packing	Walrus	11.5 lbs.	1.80	20.70	--
	Packing 5/8" x 5/8"	9.0 lbs.	.75	6.75	27.45
All walrus	Walrus	23 lbs.	1.80	41.40	41.40

1/ Based on latest available cost figures in 1941. The weights of the materials are given so that costs may be computed if and when prices change. Nails, glue, and hardwood pegs are also needed but the quantity of these materials required will be the same regardless of type of roller.

The survey at the commercial roller gins in operation in 1940 showed that only one gin out of the 22 with 40-inch rollers was operating its rollers at a speed near 150 revolutions per minute. The speed of the rollers on these gins ranged from 100 to 140, and averaged 125 revolutions per minute.

Table 7. - Averages of certain quality elements of the lint, and other factors associated with variations in roller speeds

Roller speed	Effect of roller speeds on:				
	Grade	Staple	Bale weight 1/	Ginning time per stand 1/	Lint ginned per stand per hour
R.P.M.	Steps	1/32-inch	Pounds	Minutes	Pounds
110	4.0	51.0	429	588	41.5
150	4.2	51.0	429	496	49.2

1/ For 1,500 pounds of seed cotton.

For maximum gin performance the roller should be set with the same pressure throughout the length of the fixed knife. This pressure should be sufficient to give the gin as much capacity as possible without causing excessive heat. For obtaining maximum capacity, rollers covered with packing require greater pressure than those covered with walrus.

Doffer Construction and Speeds

One of the causes of diversity in the appearance of samples is due to the brushes that are generally used to remove the cotton from the gin rollers. With this method of doffing, the cotton is often packed, wadded, or crumpled between the rollers and the brushes. The action of the brush is to collect a mass of lint, which is folded back and forth until a sufficient quantity accumulates and falls to the floor. Until the quantity of lint thus accumulated falls to the floor, it is continuously rolled and packed by the action of the roller against the brush, so that it becomes rough and ropy in appearance. Also small wads of lint are twisted and carried between the brush and the roller and are either dropped in front of the dirt screen or behind it into the seed auger, or carried under the roller, thus causing backlash.

The folded masses of lint that are packed together by the brushes are pressed in that condition into the bales, so that, even in the same bale, there might be a wide variation in the condition and appearance of the cotton. Rough, ropy lint thus irregularly mixed with smooth straight lint often causes samples drawn from the same bale to be quite different in appearance. As is the case with two-sided or mixed bales from saw gins, the classification is based on the inferior sample. During the 1940 season, 23 of the 24 roller gins in operation in Arizona and Texas used brush sticks for doffing.

In view of the difficulties and apparent losses that are associated with this method of removing the cotton from the gin rollers, special consideration was given to the development of a better method. After a series of experiments conducted by the Department in cooperation with local ginners, it was found that a rapidly revolving auxiliary roller with flexible flaps, hence called a flapper roller, could replace the brush and give very satisfactory results 14/. By this new method the cotton is taken from the gin roller without being folded or rolled. The cotton falls behind the gin in a smooth, fluffy, uniform condition. This doffer has a combing action and has a tendency to draw out the fibers and clean the lint so that the sample is not only smoother but cleaner than would otherwise be the case.

This doffer was re-designed with metal construction at the U. S. Cotton Ginning Laboratory, and tried out experimentally with American upland cottons. It was then taken to Arizona and used in connection with a suction condenser that carried the cotton directly to the press, thereby eliminating dust and fly in the gin house.

Grade and other elements of quality, as affected by the re-designed doffer at specified speeds, are shown in table 8. The doffer improved the grade by more

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14/ Townsend, James S. Attachments for roller cotton gins. Public Patent granted, July 29, 1924.

than one-half grade step. The speed of the doffer has no effect on the performance of the gin as the insignificant differences in ginning time and bale weight show. When no doffer was used, however, the bale weight was higher than when the doffer was used, because the sample contained some foreign matter. This fact is reflected in the lower grade associated with the sample ginned without the use of the doffer.

Table 8. - Averages of certain quality elements of the lint and other factors associated with doffer speeds

Doffer speed	Effect of doffer speeds on:				
	Grade	Staple	Bale weight 1/	Ginning time per stand 1/	Lint ginned per stand per hour
	Steps	1/32"	Pounds	Minutes	Pounds
No doffer	4.6	50.9	432	138	44.6
800 R.P.M.	4.0	51.0	429	140	43.6
1,200 R.P.M.	4.0	51.1	427	140	43.4
1,600 R.P.M.	4.0	51.1	428	141	43.2

1/ For 1,500 pounds of seed cotton.

More recently, a slow speed doffer, cylindrical in design with rubber flaps, has been developed and tried out in the field and found to be more desirable than any of the other types heretofore tested (figure 5). The optimum speed for its efficient operation has been found to be about 30 revolutions per minute. Although tests of roller gin doffers have indicated that they possess considerable merit by contributing to smoother ginning of American-Egyptian cotton, intermittent seasonal static electricity and other factors have prevented the ginners in the irrigated sections of the West from adopting lint doffers.

The U. S. Cotton Ginning Laboratory is studying this and other problems in the West with a view of overcoming the obstacles to the use of a doffer such as is being adopted for sea-island cotton ginning in Georgia and Florida, where static is seldom found. Devices are needed for placing a small amount of moisture on the cotton side of the gin roller, just enough to dampen the surface without wetting the covering. Furthermore, before the doffer is adopted in the irrigated regions, most of the existing gins would have to be raised from the floor enough to provide room for the ginned lint to remain under the gin until a sufficient amount is ginned to make one charge for the press.

NEED FOR FURTHER INVESTIGATION OF AMERICAN-EGYPTIAN COTTON GINNING

There is need not only for the development of humidifying processes for overcoming the static electricity frequently encountered in connection with the

use of doffers on roller gins in the irrigated sections of the Cotton Belt, but for conditioning fibers of cottons of subnormal moisture content, before or perhaps after ginning, in an effort to preserve or restore their quality. Experiments with conditioning equipment on cotton in this condition and with drying cotton harvested in a green, damp, or wet condition, would provide definite information of the practicability of such equipment in commercial roller gins and on its influence on the quality and value of the cotton. These investigations should provide means for overcoming static electricity on gin rollers, and thereby remove the principal obstacle toward the adoption of the doffers developed by the laboratory for providing smoother ginning. Cleaning tests under controlled conditions are needed so that recommendations of types and combinations of cleaning and extracting equipment can be made with assurance.

Further field and laboratory tests of rollers of different sizes, covered with various types of covering and operated at different speeds, are essential in view of shortages now being encountered in the supply of walrus, long used in whole or in part as a roller covering. These tests will round out the body of information relative to these aspects of roller ginning. Investigations of the feasibility of modernizing existing roller gins for better capacity and efficiency would ultimately contribute to more widespread improvement in roller ginning.

The investigations heretofore outlined as being needed to provide information essential to a more complete solution of the problems involved in the ginning of American-Egyptian cotton, would not only have an ultimate favorable effect on the income from American-Egyptian production, but they would contribute to a more dependable supply of extra-long staple cotton that would meet the rigid quality requirements of fine-goods manufacturers. This would be expected to improve the competitive position of American-Egyptian in relation to imported Egyptian cotton of comparable quality, and thus give growers a more stable market for their cotton.

SUMMARY

The increased plantings in recent years of American-Egyptian cotton in the southwestern irrigated sections of the Cotton Belt, and the resurrection of old ginning machinery and the installation of newly developed equipment required to provide ample facilities for ginning these large crops of cotton, have brought about many harvesting and ginning problems and intensified others that have confronted the American-Egyptian producers and ginners for a long time. It has been estimated that more than 125,000 acres of land have been planted in 1941 in American-Egyptian cotton, mostly the SxP variety. Although SxP cotton has now virtually replaced Pima and has characteristics that make it easier to gin, this long staple cotton is now more poorly ginned than it should be, and is subject from its users to some complaints, among which are poor preparation and careless packaging.

Only about one-fifth of the American-Egyptian crops during each of the last 2 years, 1939 and 1940, fell into the grades of 1 and 1-1/2, as compared with an average of more than one-third for the previous 11 years for which quality statistics are available. Preliminary classification data on representative samples indicated that more than one-half were reduced 1/2 grade,

and 7 percent, 1 grade or more because of rough-ginning preparation. Although some of this poor preparation was considered to be associated with abnormal immaturity of the fibers caused by water shortage during the boll development and ripening period in some sections, a considerable part was due to the ginning of seed cotton of high-moisture content resulting from periodic rains during the harvesting seasons over the entire area of production. Based on ginners' reports, one-third of the American-Egyptian crop in 1940 was too damp or wet to be ginned smoothly without drying on the farms or at the gins. More than three-fourths of the crop was brought to the gins in a trashy condition, according to the ginners reporting. Delays in harvesting and undue exposure in the field, together with the almost universal practices of harvesting many burs with the cotton, account for this condition.

More care in harvesting the cotton will contribute much toward improving the quality of American-Egyptian cotton. It is a well-known fact that, if good grades are expected the cotton should be picked as promptly and as cleanly as practicable and delivered to the gin in a dry condition. The next best thing is for the gin to provide conditioning, cleaning, and extracting facilities.

In efforts to provide improved ginning service and to take care of the added production resulting from the increased plantings of SxP cotton, six new roller gin plants were installed in 1940, five in Arizona and one in Texas. The installation of these new gins increased the roller ginning facilities for American-Egyptian cotton during 1940, to 24 plants with a total of 328 gin stands, having an average volume capacity of about 100 bales per stand. The stands of all except two of these plants were of the 40-inch design, the exceptions being 72-inch stands.

Since walrus hide for roll covering is now prohibitive in price and difficult to obtain, operators of roller gins are turning to a composition packing of multi-ply rubber and cotton fabric as a substitute. Almost 60 percent of the gins in operation in 1940 had their rolls covered with one-half walrus and one-half packing, while one-fourth used all packing. One gin used one-third packing and two-thirds walrus, whereas another used two-thirds packing and one-third walrus for roll covering. The average roller speed was 125 revolutions per minute in 1940. The life of the rollers used in the 40-inch single roller-type gins averaged 140 bales for those covered with one-half packing and one-half walrus, and 275 bales for those using all packing.

Packing of various kinds, as well as methods of attaching the packing to the core of the rollers, has been tried out at the U. S. Cotton Ginning Laboratory with very good results. A new "semiself-grooving type" roller has been developed by the laboratory and found in field trials in Georgia to be a very promising contribution. It can be made up of two strips from 5/8-inch by 5/8-inch packing alternated with one strip from 3/16-inch to 1/4-inch leather belting, or with two strips from 3/4-inch by 3/4-inch packing and one strip from 3/16-inch to 1/4-inch leather belting. The material costs range from $15 to $17, as compared with $13.50 for spool-wound all-packing and $27.45 for spiral one-half packing and one-half walrus. The leather, being softer than the packing, will wear faster and provide a groove necessary for good ginning. The 3/4-inch by 3/4-inch size of packing strips are considered to be preferable.

Virtually all the roller gins in the West in 1940 employed a brush stick to aid in expelling the lint from the roller. The brush has a tendency to collect or accumulate lint and cause some of it to be wadded and twisted and discharged at intervals with the cotton, producing an undesirable diversity in the appearance of the cotton. A recent development of the U. S. Cotton Ginning Laboratory is a slow-speed rubber-flap doffer to replace the brush stick so that the cotton can be taken from the gin roller without being folded or rolled. This doffer has a combing action and has a tendency to draw out the fibers and clean the lint so that the sample is not only smoother but cleaner than would otherwise be the case. However, in areas where static electricity is sometimes prevalent, the performance of this and any other doffer is not satisfactory unless provision is made for eliminating the static electricity.

Field operations in 1940 confirmed test results of the laboratory to the effect that increased ginning capacity can be obtained and maintained successfully on roller gins by using counter-balanced crank shafts in place of the old type cranks for driving the moving knife of the gin at higher than conventional speed. Tests of crank speeds indicated that gin capacity could be increased 21 percent by an increase of 29 percent in crank speed, with no harmful effects on the grade of the cotton; in fact, the grade appeared to be slightly better at a speed of 840 revolutions per minute than at a speed of 650 revolutions per minute. Average speed of the mechanisms driving the moving knives of roller gins in the West was found to be 720 revolutions per minute. Seventy-five percent of the gins used cranks and 25 percent, eccentrics, for driving the moving knife of the gin. Indications are that with well-built and balanced eccentrics, and well-braced gins, the speed of the gins could be increased to 900 or more revolutions per minute.

Extractor cleaner-feeders are essential items of equipment in western roller gins, not only to clean roughly harvested cotton and improve its grade, but to remove burs, sticks, and heavy foreign matter so that the gins will function efficiently and adequately clean the seed. By adding a 3-cylinder cleaner and an extractor unit to a big drum cleaner in a series of laboratory tests on a 4-stand, 40-inch gin set-up, the grade of the cotton was enhanced 1.4 grade steps. The cleaning set-up, involving the big drum cleaner, the extractor unit, and the 3-cylinder cleaner, removed almost three times as much foreign material as the big drum cleaner alone, and this removal of foreign matter caused the gin stands to function more effectively in removing the lint from the seed. The additional lint removed almost offset the bale-weight loss that would have resulted by trash removal.

Quality improvements, ranging from one to four grade steps, were associated with cleaning trashy cotton in tests at commercial gins in operation during the last season. The tests showed that better cleaning was obtained with the larger-sized cleaner-extractor units than with the standard one-section units.

Further investigation to improve the ginning of American-Egyptian cotton is needed in connection with: (1) the development of humidifying processes for conditioning the fibers, and as a means for overcoming static on gin rollers and thus removing the principal obstacle toward the adoption of the revolving doffer developed by the laboratory; (2) cleaning tests under controller laboratory conditions to provide information for recommendations of more effective methods; (3) further tests on rollers of different sizes with various types of covering; and (4) determining the feasibility of modernizing existing roller gins in an effort to increase the ginning capacity and efficiency.

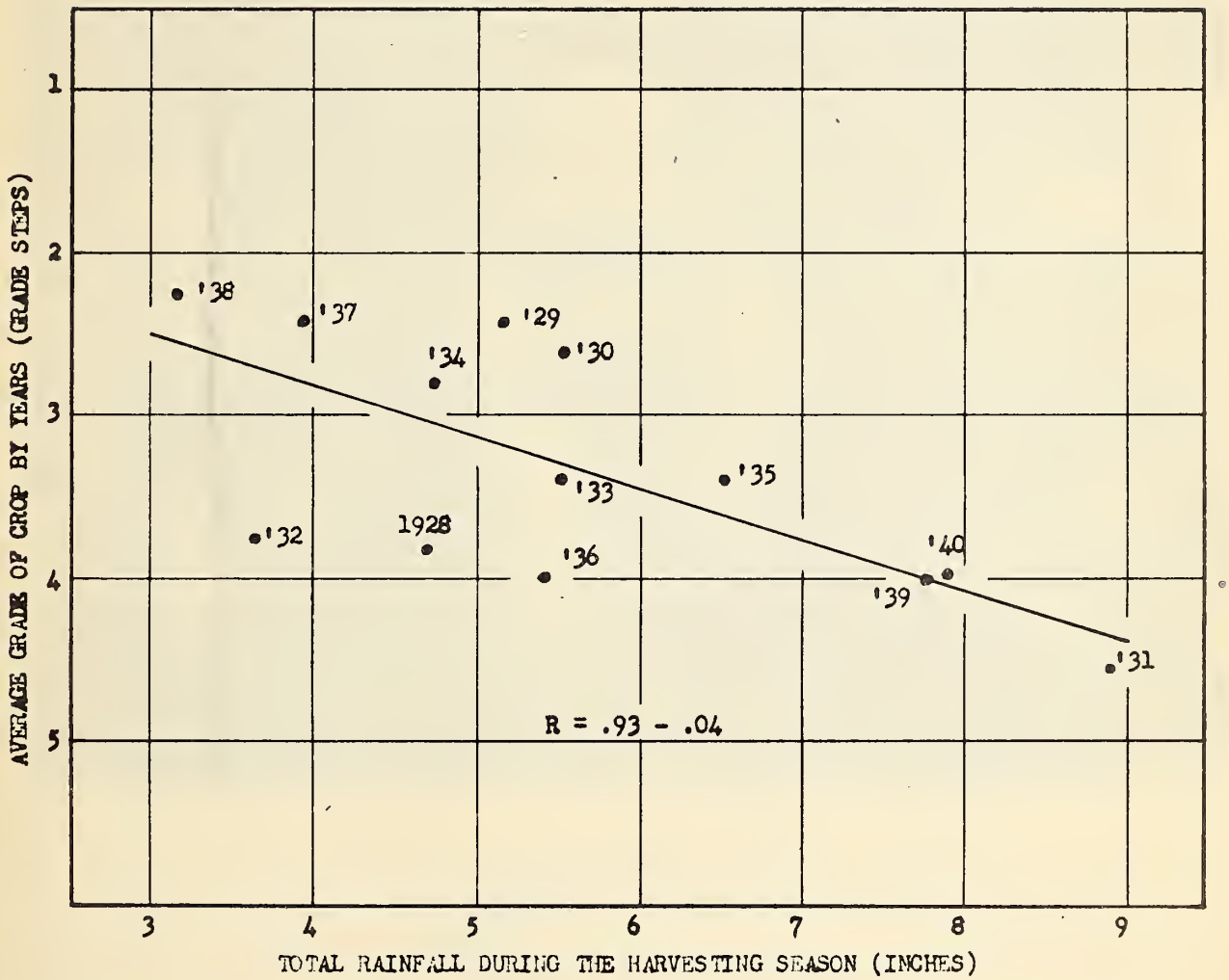

Figure 1. - Grade of American-Egyptian cotton as affected by rainfall during the harvesting season.

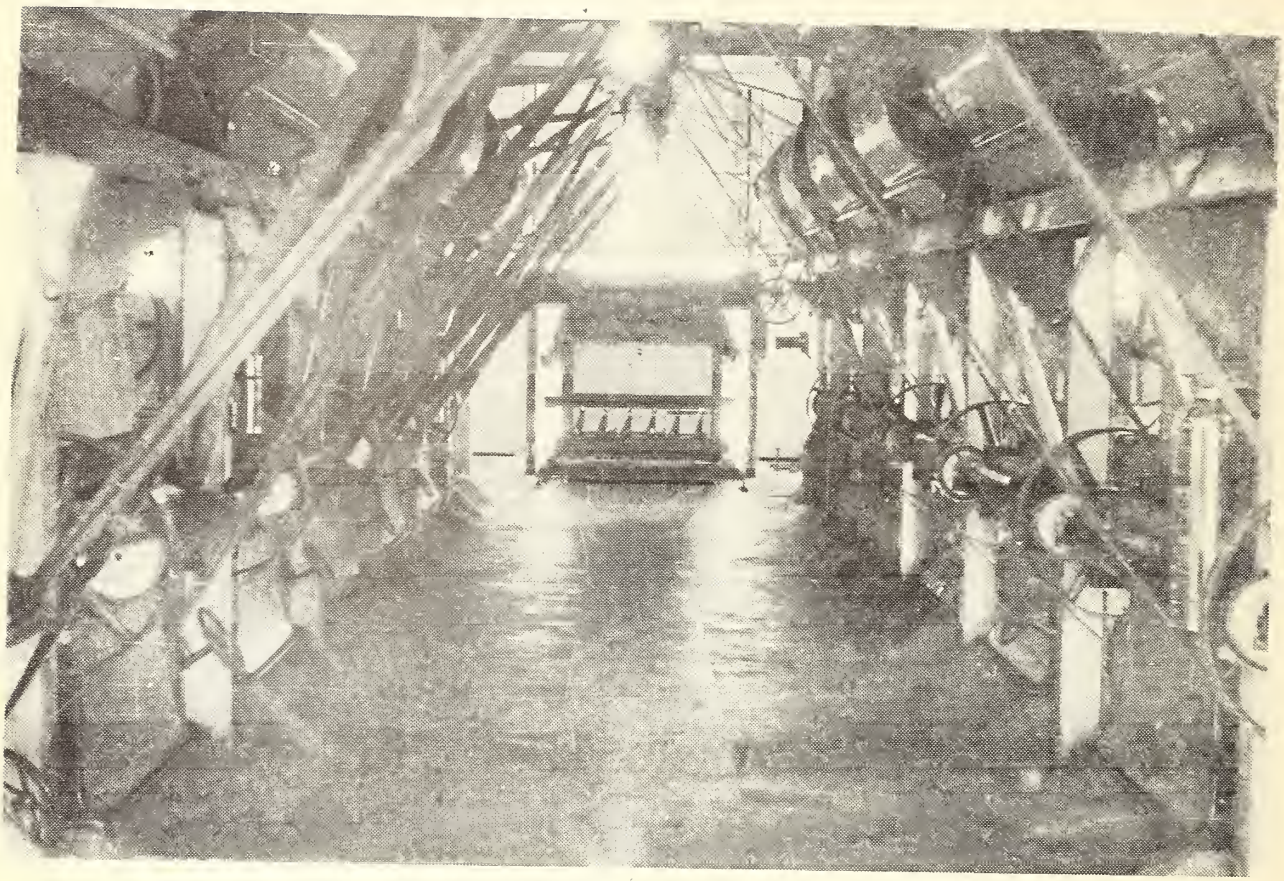

Figure 2. - An interior view of a modern roller ginning establishment.

Figure 3. - Location of roller gin plants for ginning American-Egyptian cotton, 1940.

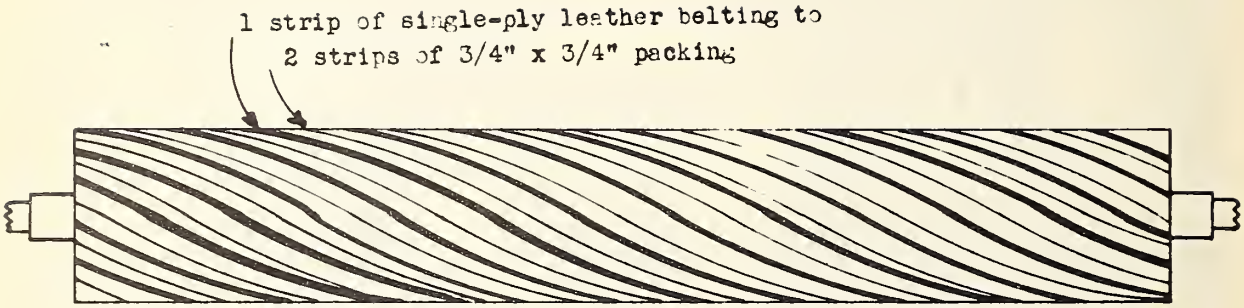

Figure 4.- Semiself-grooving type of roller for cotton gins.

Figure 5.- Slow-speed lint doffer for roller gins.